NASA TECHNICAL TRANSLATION

NASA TT F-15987

CEREBRAL BLOOD CIRCULATION INVESTIGATIONS ABOARD SOYUZ 13 -- SALYUT 3

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Translation of "Pereraspredeleniye Krovi v Nevesomosti," Meditsinskaya Gazeta, 2 August 1974, p. 3

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
WASHINGTON, D.C. 20546 SEPTEMBER 1974

STANDARD TITLE PAGE

1. Report No.	2. Government Accession No.	3. Recipient's Catalog No.
NASA TT F-15987		

4. Title and Subtitle	5. Report Date
CEREBRAL BLOOD CIRCULATION INVESTIGATIONS ABOARD SOYUZ 13 -- SALYUT 3	6. Performing Organization Code

7. Author(s)	8. Performing Organization Report No.
I. Kas'yan (Cand. Med. Sci.) and Kh. Asanov (Engineer)	10. Work Unit No.

9. Performing Organization Name and Address	11. Contract or Grant No.
Leo Kanner Associates Redwood City, California 94063	NASw-2481
	13. Type of Report and Period Covered
12. Sponsoring Agency Name and Address	14. Sponsoring Agency Code
National Aeronautics and Space Administration, Washington, D.C. 20546	

15. Supplementary Notes

Translation of "Pereraspredeleniye Krovi v Nevesomosti," Meditsinskaya Gazeta, 2 August 1974, p. 3

16. Abstract

Studies conducted during the Soyuz 13 flight dealing with cerebral blood flow in crew members F. Popovich and Yu. Artyukhin aboard the Salyut 3 space station are described. A Levkoy two-channel rheoplethysmograph was used to record and transmit rheograms and electroplethysmograms to Earth through the spacecraft's telemetric system.

17. Key Words (Selected by Author(s))	18. Distribution Statement
	Unclassified - Unlimited

19. Security Classif. (of this report)	20. Security Classif. (of this page)	21. No. of Pages	22. Price
Unclassified	Unclassified	5	

CEREBRAL BLOOD CIRCULATION INVESTIGATIONS ABOARD SOYUZ 13 -- SALYUT 3 /4

I. Kas'yan and Kh. Asanov

The absence of terrestrial gravity has an enormous effect on the functioning of one of the most important systems of the human organism -- blood circulation. Symptoms of functional changes in the cardiovascular system were noted in cosmonauts as early as the first biomedical investigations conducted on the Soyuz spacecraft. Later, with an increase in the number of persons who had been into outer space, and with the longer duration of the flights, new data appeared on the functioning of the blood circulatory system in weightlessness and also in the transition from prolonged weightlessness to g-loads and during the period of the subsequent re-adaption of the organism to the conditions of terrestrial gravity.

The redistribution of the blood in the organism is observed during weightlessness. One of the main factors causing this redistribution is the disappearance of the weight of the blood. This leads to part of the blood tending toward the upper half of the body, the vessels and organs of the thoracic cavity, and the brain. The disappearance of the blood's weight can also cause a drop in arterial pressure and a decrease in vascular tone.

The second important cause of shifts in the activity of the cardiovascular system in spaceflight conditions is the restriction of the motor activity of the cosmonaut. As a result, the venous system is deprived of the extremely efficient "muscle pump."

Thus, during weightlessness there is a substantial restructuring of the cardiovascular system to another level of functioning, which can be conditionally called the facilitated level. This restructuring is aimed at adaptation of the functional systems

of the organism to the unusual state. However, the new level of functioning proves to be inadequate when the cosmonauts return to the conditions of terrestrial gravity.

During the flights aboard the Soyuz spacecraft and the Salyut orbital station, during the first few days nearly all cosmonauts sensed the tidal flow of blood toward their heads. This was explained by the fact that a considerable amount of blood from the organs and vessels of the lower extremities goes into the system of the vena cava superior, which causes a pressure rise in it and in the auricles. As a result, there is more blood filling the intracranial veins, which evidently also causes a sense of the head being overfilled with blood, as well as the illusion of the inverted position of the body. All this leads to the deterioration of the cosmonauts' sense of well-being. Therefore, the study of blood flow into the human cerebral vessels during spaceflight conditions takes on significance.

A Levkoy two-channel rheoplethysmograph was installed on board the Soyuz 13 spacecraft; this unit was built in the All-Union Scientific Research and Experimental Institute of Medical Equipment, USSR Ministry of Public Health. The instrument is designed for the study of blood flow into the human cerebral vessels and for the transmission of rheogram and electroplethysmogram signals to Earth via the craft's radiotelemetric system. With it, cerebral blood circulation during weightlessness in aircraft flights has been investigated. It was found that in spite of large individual differences, some general regularities in the reactions of intracranial blood circulation were observed. It was established that the pulse waves of the rheoencephalogram change but little under the effect of g-loads: however, during the first several seconds of weightlessness, their amplitude decreases by 15-20 percent compared with their initial level, but then this level is restored. Evidently, 25-28 seconds of weightlessness does not yet cause a substantial change in the

blood flow into the cerebral vessels, and the changes that have been found are rapidly compensated for by the regional regulation of the cerebral blood flow.

On board the Salyut 3 scientific station manned by Cosmonauts P. Popovich and Yu. Artyukhin, several times the blood flow into their cerebral vessels was investigated, both in the resting state as well as after a metered amount of physical load. These investigations during the first days of the flight were of greatest interest. The resulting data, now being processed and analyzed, will aid in determining the buildup rates of adaptation of the organism to the state of weightlessness.